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ABSTRACT

Data from nearly 3,000 faculty in the natural sciences at 133 predominantly undergraduate colleges and universities show significant discipline- and gender-based differences in peer-reviewed publications produced. This study was part of a larger examination of the role of research in the natural sciences at undergraduate institutions. Faculty in the less populated disciplines have a higher publication rate than do faculty in the traditional natural science disciplines. Women publish less frequently than men in all disciplines except neuroscience. Another findings is that, as might be expected, publication productivity increases with rank. The population of faculty who reported their publications also reported their external grant activities. In all categories but Environmental Science Departments, women have more grant dollars per faculty member per year, and they received more grants. Another interesting finding is that the per capita grant outcome in Chemistry is smaller than in any other discipline in the natural sciences. (SLD)

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Determining Publication Productivity and Grant Activity Among Science Faculty at Survey Institutions

Research Corporation

October 2001

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Research Corporation SPECIAL REPORT OCTOBER 2001

ACADEMIC EXCELLENCE

A study of the role of research in the natural sciences at undergraduate institutions

Determining Publication Productivity and Grant Activity Among Science Faculty at Surveyed Institutions

PUBLICATION PRODUCTIVITY

Data from nearly 3,000 faculty in the natural sciences at 133 predominantly undergraduate colleges and universities show significant discipline- and gender-based differences in peer-reviewed publications. This information was submitted as one part of a larger survey entitled *Academic Excellence: A Study of the Role of Research in the Natural Sciences at Undergraduate Institutions*. Faculty surveyed were tenured or tenure-track. Sixty-seven percent of all faculty in the natural sciences at the surveyed institutions completed the surveys. The publication data was reviewed to confirm peer review and the probable origin of the publication at the surveyed institution, rather than from the faculty member's doctoral or postdoctoral work.

Tables 1 and 2 were constructed from the sum of institutional averages. In other words, each faculty member is counted within their respective institutions, and the summary data for each institution (publications per faculty member per year) is averaged according to numbers of institutions reporting at least one faculty member of that gender in the specified rank or discipline. Not all institutions had faculty in all of the listed disciplines, so that of the 133 surveyed institutions, only 19 accounted astronomy, 28 had geosciences faculty, 15 reported environmental science, and 21 provided information on neuroscience faculty. However, all institutions provided faculty reports for biology, chemistry, and physics.

Since the categorization of faculty is dependent on individual institutional administrative assignments, faculty in the categories of astronomy, geosciences, environmental science, or neuroscience are not necessarily representative of the whole. Faculty with the same work functions, research interests, and professional affiliations may be found in the traditional natural science disciplines of biology, chemistry, and physics. If this data has a

Table 1. Publications per faculty member per year, adjusted for years of service (1990–2000), averaged by institution.

	Publications per faculty member per year (1990–2000)		
Discipline	**Female**	**Male**	**Composite**
Astronomy	0.95	1.24	1.17
Biology	0.42	0.55	0.51
Chemistry	0.48	0.63	0.60
Geoscience	0.47	0.62	0.59
Physics	0.61	0.64	0.64
Environmental Science	0.65	0.87	0.81
Neuroscience	1.46	0.82	1.05

This report is the first in a series of installments on the interpretation of the data from the "Academic Excellence" study on the role of research in the natural sciences at undergraduate institutions. See page 4 for more information on the study.

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Table 2. Publications per faculty member per year, adjusted for years of service (1990–2000), averaged by institution.

	Publications per faculty member per year (1990–2000)		
Rank	Female	Male	Total
Assistant Professor	0.43	0.50	0.47
Associate Professor	0.46	0.55	0.53
Full Professor	0.61	0.67	0.66

fault it is that only publications of faculty at the surveyed institutions are counted. If a faculty member came to the surveyed institution from one that was not surveyed, only publications from the surveyed institution were counted; if a faculty member left a surveyed institution, that person was most often not included.

There are significant discipline-related differences in publications per faculty member per year. Faculty in the less-populated divisions—astronomy, environmental science, and neuroscience—have a significantly higher publication rate than do faculty in the traditional natural science disciplines. In biology, chemistry, and physics there is an overall decrease in the publication rate with increasing disciplinary size, but the factor or factors responsible for this (for example, expectations, workload, number of journals, financial support) are not known. Nor is the quality of publications (especially based on citations) known from this study. Since those reviewing the reports of peer-reviewed publications had more experience with chemistry and physics disciplines, it is more likely that more non-peer reviewed publications leaked into the final count in biology.

Women publish less frequently than men in all disciplines except neuroscience. This finding is consistent with that previously reported by Elizabeth Creamer.[1] Although why this is so is unknown, the data obtained for the Academic Excellence study are statistically relevant. Underreporting by faculty units is unlikely in the natural sciences, and spot checks on specific faculty via their web site did not reveal discrepancies in reporting. We considered that more men might have responded than their proportional representation in the faculty, but this would suggest an even higher proportion of women in the disciplines than ours (see Figures 5.2 through 5.8 of *The SourceBook*) and other data suggest.[2]

As might be expected, publication productivity increases with rank, indicating that tenure and promotion decisions are based, at least to some extent, on faculty publications. Women publish less frequently than men in all ranks with the gender difference being great-

Table 3. Publications per faculty member, adjusted for years of service (1990–2000), based on total composite of faculty in the category.

	Female			Male		
Discipline	Total Years	Number of Publications	Ratio	Total Years	Number of Publications	Ratio
Astronomy	86	83	0.96	232	312	1.34
Biology	2599	1100	0.42	6286	3470	0.55
Chemistry	1530	735	0.48	5662	3658	0.65
Geoscience	332	162	0.49	1886	1189	0.63
Physics	507	309	0.61	4511	2906	0.58
Environmental Science	64	46	0.72	208	191	0.92
Neuroscience	115	168	1.46	200	163	0.82

est at the associate professor level. Here again, the factor or factors responsible for this are unknown.

A separate assessment of publication productivity by discipline and gender is reported in Table 3. Here all faculty are accounted by discipline, independent of institution. Total years of employment for the period 1990–2000 is given along with the total number of publications resulting from faculty activity. The ratio presented is that from the number of publications divided by the total years of employment. Note that dividing the total years of employment for women by those for men does not provide a ratio of persons but does of person-years.

Although there are some differences in ratios representing the number of publications per faculty member per year between Tables 1 and 3, the largest discrepancies are in disciplines that are not highly populated and can be associated with "the tyranny of small numbers." The ratios for the traditional disciplines are remarkably alike. Thus two ways of measuring publication productivity lead to the same outcome and conclusion.

GRANT ACTIVITY

The same population of faculty who reported their publications for the Academic Excellence study also reported their external grant activities. Self-reported grant activities were reviewed, and they did not include grants designed for larger organizational units, such as those to departments, institutions, or consortia (for example, from NSF-ILI, NSF-REU, HHMI, or Research Corporation Department Development). Internal "grants" such as start-up provisions and student or faculty summer stipends were not included. Both education/outreach and research grants were counted. Research grants accounted for 89% of the total dollars reported. Additional details can be found in Section 5 of *The SourceBook*.

The total external grant dollars was $90,724,791 (1,662 grants) reported for women and $279,193,853 (5,472 grants) reported for men. The total external funding that was reported by the institutions was $559,442,530 for the same institutions plus three others, so the amount reported by faculty is 66% of the total reported by institutions. Since the total number of faculty reporting is

Table 4. External grant dollars and number of grant awards per faculty member per year, adjusted for years of service (1990–2000), averaged by institution.

	Female		Male	
Category	Grant $	Grant #	Grant $	Grant #
All Faculty	17,129	0.31	14,455	0.28
For Assistant Professors	16,097	0.30	14,984	0.29
For Associate Professors	15,914	0.32	11,877	0.26
For Full Professors	20,699	0.34	15,657	0.30
Astronomy Departments	28,775	0.63	21,537	0.45
Biology Departments	16,175	0.26	13,520	0.25
Chemistry Departments	13,947	0.31	12,707	0.30
Geoscience Departments	17,400	0.43	13,775	0.32
Physics Departments	20,485	0.30	15,702	0.24
Environmental Science Departments	36,706	1.23	56,033	1.35
Neuroscience Departments	45,689	0.40	20,573	0.22

67% of the total number of faculty at these institutions in 2000, we believe that the numbers reported are representative. The percent response of faculty for each surveyed institution is given in Table 5.1 of *The SourceBook*.

In all categories but Environmental Science Departments women have more grant dollars per faculty member per year, and they received more grants. There is consistency in these differentials through disciplines and by ranks. The difference is not due to the availability of gender-specific programs, since such awards constitute a very small fraction of the total.

An important revelation comes from the per capita grant dollars available to chemistry faculty, which is the lowest of all of the disciplines. There is a common perception that there are more foundations and agencies that support research in chemistry than in any other discipline. In other words, it's thought to be easier to obtain funding in chemistry than in other disciplines. It may be easier, although certainly not greatly so, but the per capita outcome is smaller in chemistry than in any other discipline in the natural sciences. ■

[1] Elizabeth Creamer, *Assessing Faculty Publication Productivity*: Issues of Equity. 1998, Jossey-Bass.

[2] For example, *Women in the Chemical Workforce*, a Workshop Report to the Chemical Sciences Roundtable, National Research Council, Washington, D.C., 2000, and demographic data from the American Institute of Physics at www.aip.org/statistics/trends/undtrends.htm).

ACADEMIC EXCELLENCE

Results from a comprehensive study of the environment for research in the natural sciences at predominantly undergraduate colleges and universities have been published in *Academic Excellence: The SourceBook*—539 pages of data and opinions which constitute an important resource for defining the current status of the natural sciences at the 136 surveyed institutions and in the broader universe of undergraduate institutions. These schools have served as a national resource for a significant proportion of students who undertake professional careers in the sciences, and a primary reason cited for their output has been the research experiences of undergraduate students with faculty mentors.

However, prior to this study there was a growing perception that resources and productivity were declining. Concern over these perceived trends by five private foundations with interests in the natural sciences (Research Corporation, the M. J. Murdock Charitable Trust, the W. M. Keck Foundation, the Welch Foundation, and the Camille and Henry Dreyfus Foundation, Inc.) prompted the intensive data collection and analyses for *Academic Excellence: A Study of the Role of Research in the Natural Sciences at Undergraduate Institutions*.

Copies of *The SourceBook* are available from Research Corporation. Orders must be prepaid by check or money order; $50.00, includes priority rate postage.

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